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Case Report

False positive computed tomographic angiography for Stanford type A aortic dissection

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ABSTRACT

Background: Computed tomographic angiography (CTA) has emerged as the defacto imaging test to rule out acute aortic dissection; however, it is not without flaws. We report a case of a false-positive CTA with respect to Stanford Type A aortic dissection.

Case: A 52 year-old male presented with sudden onset shortness of breath. He denied chest pain. Due to severe hypertension and an Emergency Department bedside ultrasound suggesting an intimal flap in the aorta, CTA was requested to better assess the ascending aorta and was interpreted as consistent with Stanford Type A aortic dissection with thrombosis of the false lumen in the ascending aorta. However, intra-operative imaging (TEE and epi-aortic scanning) did not identify an intimal flap or dissection, and neither did definitive surgical inspection of the aorta. The suspected aortic dissection and thrombosed false lumen were not visualized on repeat CTA two days later.

Discussion: False positive diagnosis of Stanford Type A aortic dissection on CTA can be the result of technical factors, streak artifacts, motion artifacts, and periaortic structures. In this case, non-uniform arterial contrast enhancement secondary to unrecognized biventricular dysfunction resulted in the false positive CTA appearance of an intimal flap and mural thrombus. Intra-operative TEE and epi-aortic scanning were proven correct in excluding aortic dissection by the standard of definitive surgical inspection of the aorta.

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Introduction

Acute aortic dissection is the most common catastrophic condition involving the thoracic aorta and in most cases of proximal aortic dissections, if undiagnosed, has a fatal outcome. Various noninvasive imaging modalities exist to evaluate aortic dissection including transthoracic echocardiography, transesophageal echocardiography, contrast-enhanced chest computed tomographic angiography (CTA), contrast-enhanced electrocardiogram (ECG)-gated cardiac and/or chest computed tomography, and magnetic resonance angiography [1,2].

With widespread availability, a purported sensitivity of 100% and a specificity of 98%, a short acquisition time, and a superior ability to evaluate branch vessel involvement, CTA has evolved to be the defacto imaging test of choice to identify or exclude thoracic aortic dissection [2]. However, it is not without flaws. There are a handful of documented cases in radiologic and surgical literature describing false positive diagnosis of acute thoracic aortic dissection using CTA. This case adds to the literature.

Case history

A 52-year-old Asian male presented to a community hospital emergency department with sudden-onset shortness of breath after 2–3 days of fever, chills, and productive cough. He denied any chest pain at the time of presentation. He had no significant coronary risk factors and was not on any medications. On examination, he had severe hypertension (220/160 mm Hg). An emergency department bedside ultrasound was interpreted as intimal flap in the aortic arch (Fig. 1). CTA was subsequently performed, which was interpreted as consistent with Stanford type A aortic and a thrombosed false lumen in the ascending aorta (Fig. 2 and 3).

The patient was then transferred to our institution, where he underwent emergency surgery and had a moment of respiratory arrest with pulseless electrical activity just after the induction of anesthesia. He was put on immediate cardiopulmonary bypass and given inotropes postoperatively. The pericardium and pleura were filled with straw-colored fluid without blood. Intraoperative transesophageal echocardiographic findings did not confirm aortic dissection. Significant right and left ventricular systolic dysfunction were present. An intraoperative epiaortic ultrasound depicted a normal ascending aorta (Fig. 4 and 5), contradicting CTA findings as did the intraoperative transesophageal echocardiogram (TEE). Definitive surgical inspection of the aorta was performed at the mid ascending aorta, and the entire ascending aorta was examined down to the level of the aortic valve. The surgical appearance of the aorta was normal and without apparent intimal disruption or clot. The previously suspected type A dissection with thrombosed false lumen is not visualized according to electrocardiogram-gated coronary computed tomography angiography performed 2 days postoperatively (Fig. 6).

Discussion

CTA has become the defacto imaging test to diagnose acute aortic dissection and other acute aortic syndromes. After injection of iodinated contrast, 2 distinct lumens divided by an intimal flap should be visualized to make the diagnosis [2]. Helical and multisectonal CT have the advantage of shorter acquisition time, high diagnostic accuracy, and are more accurate than magnetic resonance imaging and transesophageal echocardiography at detecting branch vessel involvement [1]. More accurate delineation of a proximal intimal flap in relation to the aortic valve and coronary arteries is made possible using ECG-gated CT and is evolving to be the more common protocol for CTA for suspected aortic dissection [2,3].

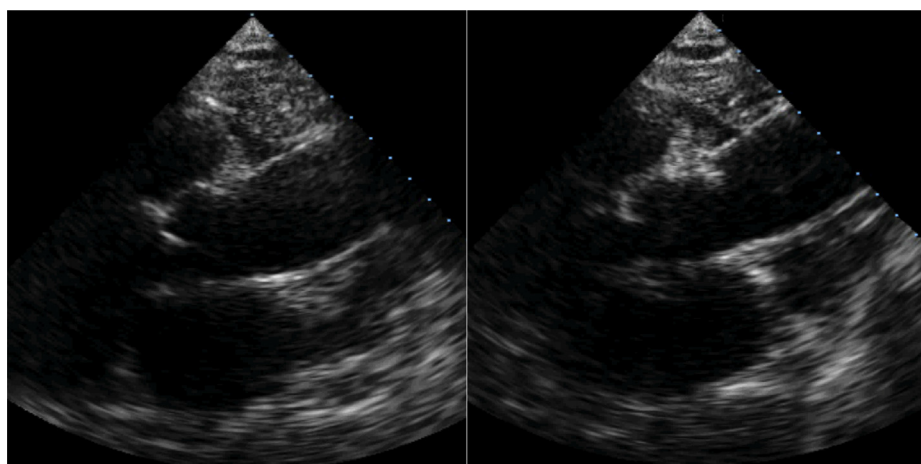


Fig. 1 – Transthoracic images of the ascending aorta, parasternal long axis (left image), and high parasternal long axis (right image). On the left image, the appearance of the ascending aorta is normal in so far as dimension, shape, and the absence of intimal flap or thickened wall. On the right image, there is a faint linear entity in the ascending aorta, thinner than a usual intimal flap, of more uniform radius with respect to the image sector than the usual intimal flap, and with appearance typical of a reverberation artifact.

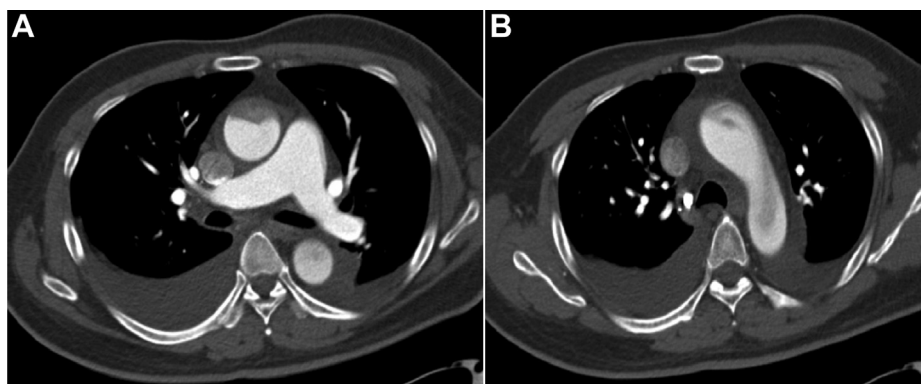


Fig. 2 – Contrast-enhanced axial images of the upper thorax from the community hospital. Differential contrast opacification of the ascending aorta is visualized (A) and was interpreted as consistent with a thrombosed false lumen in the ascending aorta, although the same differential contrast pattern is seen in the superior vena cava. The vague varying linear low attenuation matter in the ascending aorta and aortic arch (B) was interpreted as an intimal flap, poorly depicted potentially due to motion artifact. Also seen are moderate-sized pleural effusions, which increased the concern and/or bias for the presence of an underlying acute aortic lesion.

Streak and motion artifacts, technical factors, and periaortic structural abnormalities are well documented within the literature to generate false positive findings of aortic dissection. Streak artifacts caused by high-attenuating materials such as staples, clips, stents, or calcifications may produce beam hardening resulting in the appearance of an intimal flap [4,5]. Cardiac motion from the left ventricular free wall over the descending aorta or aortic wall motion during systole and diastole can produce motion artifacts resembling a thoracic aortic dissection [4,6]. Technical factors such as delayed contrast enhancement of the aorta and branching arteries can be interpreted as thrombosis of the false lumen [2–4]. Periaortic structures such as a low-lying brachiocephalic vein passing anterior to the aortic arch can simulate an aortic arch dissection [4]. The superior pericardial recess, in the presence of hemopericardium or a thickened pericardium, has a higher attenuation and can mimic a Stanford type A dissection on axial sections [7,8]. An atelectatic lung adjacent to the descending aorta can resemble an intimal flap, and when it is enhanced by contrast, it can simulate a false lumen [4].

We hypothesize that in this case, because of the clinically unrecognized severe biventricular dysfunction, which was later clinically suspected to be because of myocarditis, there was flow streaming heterogeneity and gravitational sedimentation of contrast dye in the ascending aorta leading to poor admixing of contrast. The gravitational nature of the artifact is apparent in the ascending aorta and superior vena cava in Figure 2A, and the longitudinal linear nature of the flow heterogeneity is apparent in Figure 2B. The severity of the ventricular systolic dysfunction was proven by the pulseless cardiac arrest that occurred after induction of anesthesia. With adequate inotropic support postoperatively, the patient survived.

The comprehensive nature of the imaging in this case revealed discordance of imaging findings. The directed trans-thoracic echo images yielded false positive findings because of lack of recognition of radial reverberation artifact and false positive interpretation of the artifact. The initial non-ECG-gated CT scan had similar findings in the superior vena cava and the ascending aorta with respect to posterior sedimentation of dye. Finally, the presentation of aortic dissection without

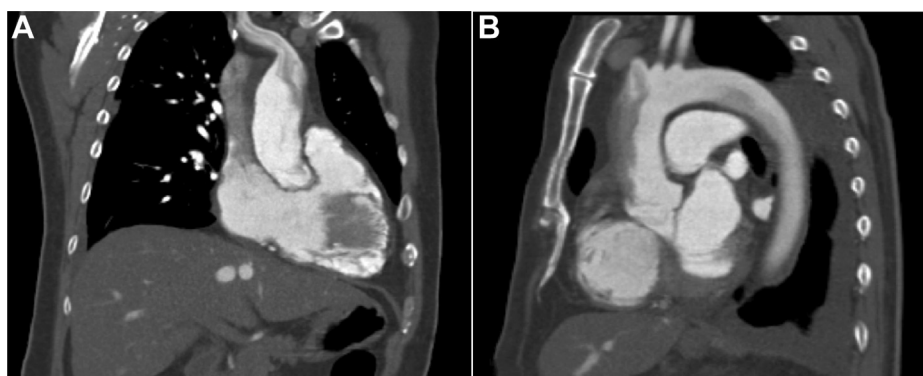


Fig. 3 – Contrast-enhanced coronal and sagittal computed tomographic images of the thorax and upper abdomen. (A) The left image depicts imperfect outlines of the margins of the ascending aorta. (B) Low attenuation linear findings enter the left brachiocephalic artery in duplicate or triplicate. This was interpreted as an intimal flap, with motion artifact resulting in the duplicate and/or triplicate image. False positive findings due to dye-streaming were not considered at the time.

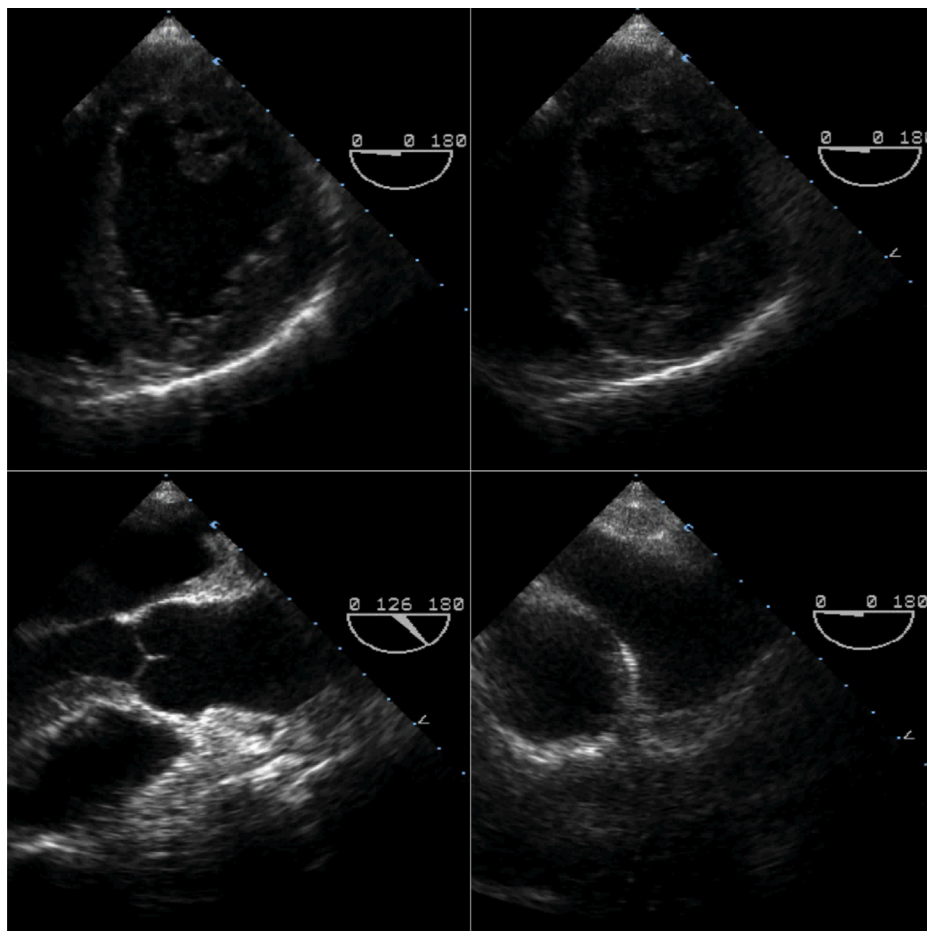


Fig. 4 – Intraoperative TEE findings. Upper images: transgastric short axis images of the left ventricle in diastole (upper left image) and in systole (upper right image). There is severe global left ventricle systolic dysfunction. The patient became pulseless after induction of general anesthesia. Lower right image: TEE long-axis view of the aortic root and ascending aorta. The imaging quality is adequate, and no intimal flap is seen on this plane of imaging to the level of the aorta imaged. Lower right image: TEE short-axis view of the ascending aorta. The image quality is adequate, and no intimal flap is seen at this level of the aorta. TEE = transesophageal echocardiogram.

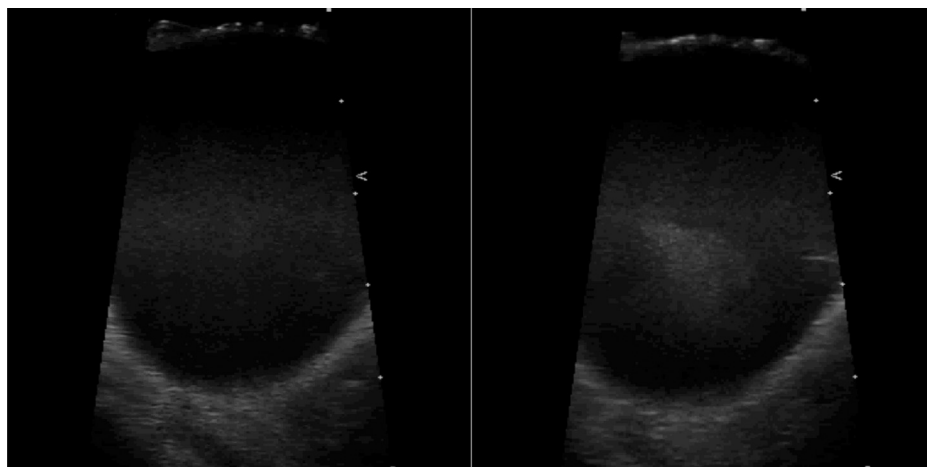


Fig. 5 – Intraoperative epiaortic scanning reveals an absence of intimal disruption, intimal flap, and intramural hematoma. Intermittent spontaneous echo contrast is seen (right image), consistent with “low-flow.” The regionality of the spontaneous echo contrast is consistent with heterogeneity of flow.

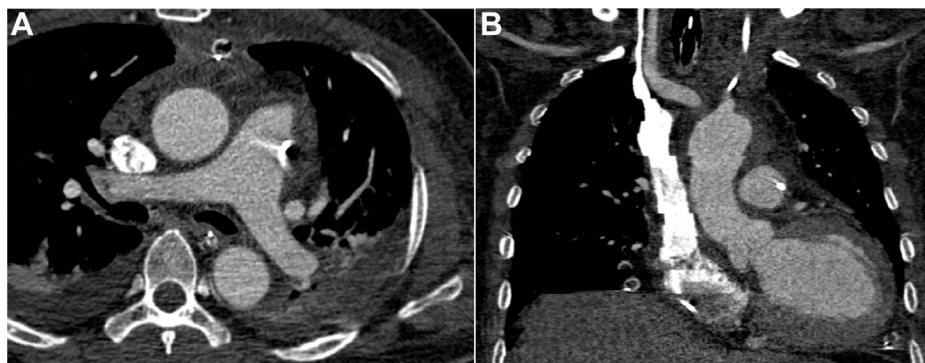


Fig. 6 – (A) Axial and (B) coronal images from the electrocardiogram-gated coronary computed tomography angiography performed 2 days postoperatively. Despite the presence of extensive motion artifact, the previously suspected type A dissection with thrombosed false lumen is not visualized. The ascending aorta and right brachiocephalic artery are without evidence of dissection. Because of ongoing severe ventricular dysfunction, the timing of the image acquisition is again premature.

chest pain is less than 3%, and usually in the context of syncope or stroke. The dyspnea that this patient presented with was because of the severe, unrecognized, biventricular dysfunction and heart failure, and that resulted in the dye flow-streaming and gravitational dispersion artifact resulting in the initial CT scan appearance and epiaortic ultrasound scans.

Conclusion

Although CTA is the defacto test of choice to diagnose aortic dissection, this case illustrates that non-ECG-gated CTA has potential false positivity due to premature acquisition and poor dye mixing due to low-flow (low cardiac output and/or shock states) resulting in differential flow and/or dye streaming in the ascending aorta and gravitational dispersion of the dye posteriorly.

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